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DIRECTORATE OF PLANS

# RESEARCH AND ENGINEERING

MONOGRAPH

radar

# THE SOVIET SRO-2/KHROM IFF TRANSPONDER

STATUS: JULY 1968

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Excluded from automatic downgrading and declassification

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## SUMMARY

This report describes the Soviet airborne SRO-2/Khrom transponder (IFF) that was installed in the MIG-17 which landed in the HOECHSTAEDT area on 26 May 1967. This transponder is an airborne component of the Soviet L-band secondary radar system.

Since the instrument was available for examination for only a very brief period of time, the examination of it was only superficial. For this reason, no detailed technical description can be given; however, certain connections were confirmed and certain details were learned, and both are explained in the description of the functioning of the equipment. The differences between the SRO-2/Khrom and its predecessor, the SRO-1/Barium, were ascertained.

The SRO-2/Khrom is a transponder beacon which responds only when it is interrogated by airborne, ground, and presumably also shipboard radars, in the S- or X-band in coincidence with a 670-MHz interrogation signal or a coded interrogation in the 670-MHz band. In addition to the target blip, an identification signal then appears on the display of the interrogating radar.

The advantage of the SRO-2/Khrom over its predecessor involves the following main points:

For the SRO-2/Khrom the interrogation must be encoded or in coincidence with the interrogation radar pulse; the transmission duration per response amounts to 3.5 microseconds as compared to 3.2 seconds; the response is displayed on the screen (PPI-display) of the interrogating radar.

C O N T E N T S

III. The Indication

1. Response Representation On PPI-Display of Interrogating Radar

a) Interrogating Radar in the S-Band

b) Interrogating Radar in the X-Band

c) Interrogating Radar in the L-Band

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II. Minor Lobe Interrogation

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1. Operating Frequency

2. Interrogation

3. Response

4. Response Representation

25X1
25X4

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This ground interrogation radar used in the SRO-2 system can operate with the well known antennas of the WITCH or SCORE BOARD series. Vertical dipoles oriented in the focal plane of the main radar along with its primary radiators could also be used for interrogation, however, as is the case with the ground radar BAR LOCK. This would make favorable use of the sharper focus through the relatively large reflectors of the main radar set (better azimuth resolution and greater accuracy). The airborne radar SRZ-2 ("самолетный радиолокационный запросчик" - samoletnyy radiolokatsionnyy zaproschik - airborne radar interrogator) operates with the ODD RODS antennas.

The interrogator used with the SRO-1/BARIUM operates with the FISH NET antenna, whose poor focus (halfwidth about 30°) and indication on a separate A-display often caused confusions.

B. The Arrangement of the SRO-2 in the MIG-17

The arrangement of the SRO-2 in the aircraft is practically the same as that of the SRO-1. Only a few new parts have been added. (See sketch)

As before, the electronics deck contains: transceiver 1, power pack 2 under the RSIU-3M radio; safety switch 3 and inertial switch 4 on the left sidewall at the top. The matching unit 5 ("Instrument 39") is on the right sidewall. The parts mounted in the cockpit include: control box 6 just behind the pilot's right shoulder on the right sidewall (hard to reach). Its control knob for the IFF code is out of commission; in its place is a separate control knob 7 on the right sidd of the front instrument panel. The destruct switch 8 is mounted on the front of the righthand instrument panel and has an additional

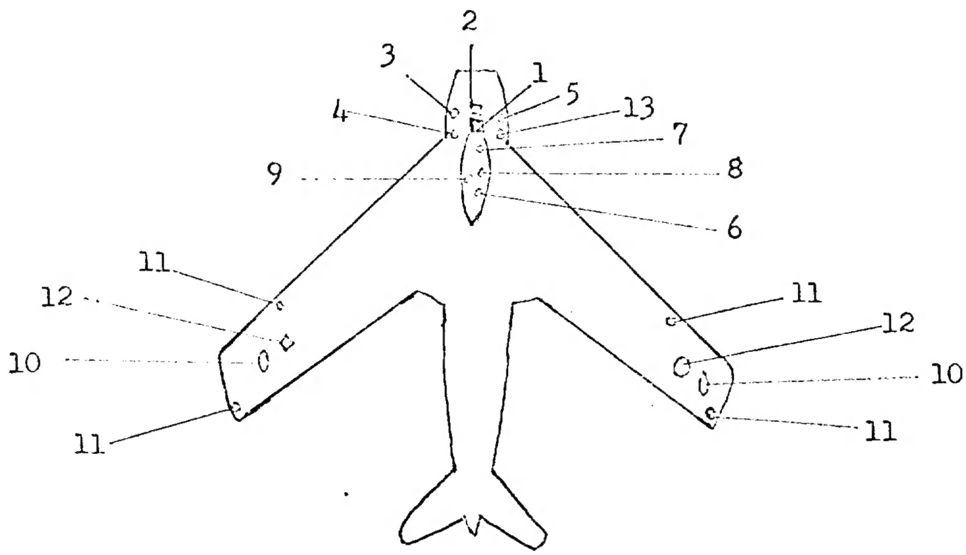
emergency-signal button.

The vertically polarized transmit-receive antenna for the L-band 9 is on the underside of the fuselage forward. The corresponding antenna of the SRO-1 used to be mounted on the top of the fuselage between cockpit and control surface.

New parts since the SRO-1: One BEAN SHELL antenna 10 on the underside of each wing tip; four PIN HEAD antennas 11 arranged at the edge of the wing so as to provide four pointing directions 90 degrees from one another.

In the tip area of each wing there is an antenna connection box 12, called "Block 23 P" (unit 23 P).

Unit 12-4 (13 on the sketch) is in the electronics deck on the upper right sidewall.




Arrangement of SRO-2. See Text For Numbered Items.

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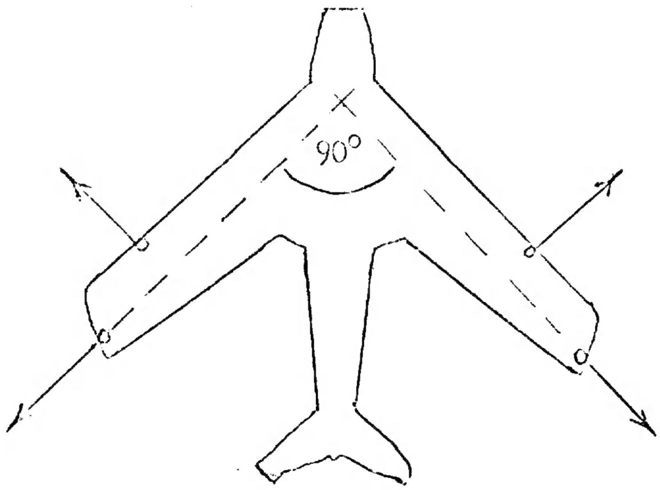


Arrangement of the PIN HEAD Antennas
Arrows Show Centers of Radiation Directions

C. Description of the Subassemblies

The SRO-2 in the MIG-17 is made up of the following subassemblies:

| Subassembly | Soviet Designation |
|---|---|
| Transceiver with coder | Unit No 5-0 |
| Control box | Unit 8 A |
| IFF-Code setting knob | Unit 8 B |
| Converter and power pack | |
| Self destruct | |
| Transmit-receive antenna | |
| BEAN SHELL antennas | Instrument 12-12 (two) |
| PIN HEAD antennas | Instrument 12-10, or 12-11 (four) |
| Video connection boxes | Unit 23 P (two) |

| | |
|---|---|
| Matching Unit | Instrument 39 |
| Diode tester | Unit 12-4 |

I. Transceiver With IFF Coder

The transmitter and receiver (See Enclosures 7-10, Figures 12-18) are contained in a common housing the same size (32 cm long, 30 cm high and 20 cm deep) as the housing of the SRO-1/BARIUM. The design is much more compact than that of the SRO-1, however; about three times as many tubes, etc., are confined to the same space as before. The transmit-receive switch for the L-band frequency is a gas diode. Unused connections 3 and 9 on the receiver and 5 and 8 on the transmitter could, in conjunction with an airborne radar and possibly additional devices, be used for enlarging the installation into an interrogator-responder.

1. Transmitter and IFF Coder. About three-quarters of the space in the common housing is taken up by the transmitter and the IFF coder, which is located under an arched raised section. The explosive charge is in the IFF coder (Enclosure 8, Figure 13 and Enclosure 13, Figure 24). The control box and control button for the IFF code (Enclosure 11, Figures 19-20 and Enclosure 12, Figure 21) are attached to 16-position connector 7 (Enclosure 7, Figure 12 and Enclosure 8, Figure 13). A 7-position test connector (Enclosure 13, Figure 23 left) is attached to the terminal marked "Kontrol-1" (Test-1). The coaxial cable of the 670-MHz transmit-receive antenna leads to connector 6. Connectors 5 and 8 are not used. Two fans, which can be seen on the left and right sides in Enclosure 9, Figure 16, are

installed in the transmitter section. Between them is the self-excited output stage. The transmitting frequency is 670 MHz.

The coder is housed in a lead-sealed cylindrical shield about 11 centimeters in diameter and 18 centimeters high. The explosive charge is also contained in it (Enclosure 8, Figure 13; Enclosure 9, Figure 15; and Enclosure 13, Figure 24). Depending on the position of the IFF code control knob (Enclosure 11, Figures 19 and 20), one of the following twelve pulse repetition rates, separated by about 0.7 Mhz, can be selected:

| | | | | | |
|---|---|---|---|---|---|
| 1.7 MHz | 2.3 MHz | 3.0 MHz | 3.7 MHz | 4.3 MHz | 5.0 MHz |
| 5.7 MHz | 6.3 MHz | 7.0 MHz | 7.7 MHz | 8.3 MHz | 9.0 MHz. |

Depending on the frequency, the pulse width varies between 60 and 200 nanoseconds; the pulse train width is about 3.5 microseconds; the pulse repetion rate here is equal to the pulse repetition rate of the interrogating radar.

2. Receiver: The upper third of the common transmitter/receiver housing is taken up by the receiver. It is a superheterodyne receiver for the L-band interrogation frequency and contains one triple pulse decoder and one coincidence stage.

Just below the receptacle marked "КОНТРОЛЬ 2" ("Kontrol'-2" = "Test 2")(Enclosure 8, Figure 14) is connector 4, a 4-position test receptacle for connecting up the diode tester, "БЛОК 12-4" = "Block 12-4" = Unit 12-4; The coaxial cable from the matching unit for the passive S-band and X-band antennas connects up to receptacle 2.

Connections 3 and 9 are not used. Under a hinged cover (Enclosure 8, Figure 14) there are two switches and two adjusting knobs. The left switch has three positions, "3", "НОРМ"(NORM), and "1"; when the cover is closed, the switch is held in the "NORM" position by a slide bar. The adjusting knob under the left switch is marked "усиление 3"("Gain 3").

The right switch has two positions, "ПР-1 - КГ-1" ("PR-1" = /most likely "Instrument 1"/ and KG-1 /for "калибратор глубой" = coarse calibrator ?/; when the cover is closed, the switch is held in the "PR-1" position. The adjusting knob is marked "усиление 1" ("Gain 1"). Perhaps these switches and trimmers are used for adjusting the receiver response sensitivity or for adjusting the coincidence stage and triple pulse decoder.

II. Control Box (Enclosure 12, Figure 21)

The control box has two mechanically connected toggle switches for the code and power sections with two corresponding signal lamps, one slotted-head screw for voltage regulation, three fuses, one two-position test receptacle for 115 volts, 400 Hz, one emergency switch shielded by a lead-sealed cover, one signal lamp for indicating when the set responds. The IFF code control knob has a sheet metal cover with an inscription pointing out the remote code adjustment knob. For the sake of comparison, Enclosure 12, Figure 22 shows a view of the control box with the cover removed from the code control knob.

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III. IFF Code Setting Knob

The remote IFF code setting knob (Enclosure 2, Figure 2 and Enclosure 11, Figures 19 and 20) has 12 positions; the setting at the time is indicated as a number which is visible in a round opening.

IV. AC Converter and Power Pack (Enclosure 3, Figure 4)

The converter is fed by the airborne battery and delivers a single-phase AC of 115 volts, 400 Hz, 4.35 amps. The power pack for the SRO-2 is housed in a box attached directly on top of the converter. A multi-conductor cable leads to the control box.

V. Self Destruct:

The power circuit to the self destruct is connected directly to the aircraft battery. These components are the same as in the SRO-1/BARIUM; one lead is even marked "BARIUM DESTRUCT" (Enclosure 15, Figure 28). The component marked "переносная лампа" (portable lamp) could be a warning light.

The detonation charge (Enclosure 13, Figure 24) consists of two cartridges about 6 centimeters long and about a thick as a pencil. The inertial switch (Enclosure 14, Figure 25) is adjustable up to 10 g.

The destruct switch in the cockpit (Enclosure 14, Figure 26) contains an additional emergency signal switch, a signal lamp and a safety cut-out switch for the destruct circuit, "хром взрыв" ("Chromium destruct").

The cut-out switch has (Enclosure 15, Figure 17) a switch with the positions "хром взрыв" - "выкл" ("Chromium destruct" - "OFF"). The warning light has the inscription, "Do not switch on when lamp is burning." ("лампа горит не вкл") Enclosure 17 shows the destruct circuit.

VI. Transmitting/Receiving Antenna

The antenna used here for receiving and transmitting the vertically polarized 670-MHz interrogation and response signals is a quarter-wave radiator (without the directors and reflectors ordinarily used with the ODD RODS) with an omnidirectional radiation pattern (Enclosure 4, Figure 5).

The antenna is mounted forward on the underside of the fuselage and is connected to plug 6 of the transmitting section by means of coaxial cable.

VII. BEAN SHELL Antennas

Both antennas were damaged during the belly landing (Enclosure 4, Figure 6 and Enclosure 5, Figure 7). BEAN SHELL is a nondirectional antenna and consists of a stub (vertical polarization) and a slot (horizontal polarization) with a separate lead to each and a type D 403 B germanium wide-band diode for 3-12-centimeter wavelength each, or a type D 403 W for 9.8-centimeter wavelength each. The antenna is adapted for reception in the S-band.

VIII. PIN HEAD Antennas (Enclosure 4, Figure 6 and Enclosure 5, Figure 8)

An omnidirectional directivity pattern is achieved through the

arrangement of four PIN HEAD antennas on the wing edges with beam directions port and starboard forward and port and starboard aft. PIN HEAD is adapted for any polarization and operates in the X-band. In the lead-in there is a type D-403 B diode; reception only is possible. A coarse indication of the direction from which an X-band beam arrives would be possible, but is not utilized; there is no possibility available for such an indication.

IX. Video Connection Boxes

In each wing tip area there is a video connection box "Unit 23 P" (Enclosure 6, Figure 9) with video inputs (two from each PIN HEAD, two from BEAN SHELL). A common output leads via coupling capacitors and coaxial cable through a matching unit, "Instrument 39" (Enclosure 6, Figure 10), to receiver connector 2 and to the coincidence stage.

A quad cable forms, through RC filters, a separate output for the four video inputs and leads through the diode tester, "Unit 12-4" to receiver connector 4.

X. Matching Unit

"Instrument 39" (Enclosure 6, Figure 10) combines the video signals of the two "Units 23 P" via coaxial cable. The output is connected by coaxial cable to receiver connector 2 and then presumably to the coincidence stage. "Instrument 39" could well be a matching unit.

XI. Diode Tester

"Unit 12-4" (Enclosure 7, Figure 11) acts here, presumably,

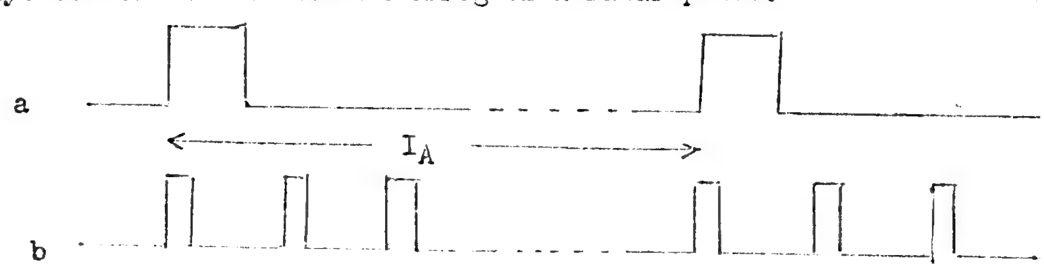
only as a test connection for the diodes of the S-band and X-band receiving antennas; the diodes pertaining to the connectors are handwritten on the screw cap of the test connector. "Unit 12-4" is connected by a quad cable to the two video junction boxes. A 4-position connector leads to receiver connector 4.

D. Description of Function

I. Interrogation

1. The Interrogation Signal

To identify a target, the radar observer switches on his IFF while the antenna directivity pattern moves through the appropriate target sector. The appropriate foot switch or marker button on the display must be depressed for the duration of the desired interrogation period. A coded interrogation in the L-band, synchronized with the pulse repetition rate of the interrogation radar, is then beamed at 670 MHz. The interrogation consists of a group of three pulses, each with a width of about 0.8 microsecond, and a separation [spacing ?] of about 4 microseconds. The first pulse of the group always coincides with the interrogation radar pulse.




a - interrogating radar pulse
b - interrogation pulse of the secondary radar

The time $I_A$ results from the pulse repetition rate of the interrogating radar; if, for example, the PRR is 375 pulses per second, then $I_A$ = 2,666 microseconds.

## 2. Testing the Interrogation Signal of the SRO-2

The SRO-2 responds to two types of interrogation:

a) to a group of 3 pulses each with a width of about 0.8 microsecond about 4 microseconds apart at a frequency of 670 MHz. The response is sent after the last pulse in the group;

b) to the first pulse in the group according to a) above in coincidence with the pulse of the interrogating radar in the S-band or X-band. The response is sent practically without hesitation after the first pulse in the group.

Case a): The aircraft is first swept by the beam of the secondary radar antenna, which is broader than that of the interrogation radar. In the SRO-2 receiver the interrogation signal is tested for validity. The pulse spacings are measured; if they are within the admissible tolerances, the third pulse in the group triggers the transponder. The time lapse between the arrival of the first pulse in the group and the transmission of the response signal amounts to about 10 microseconds, which corresponds to a range of 1.5 kilometers on the display.

Case b): When the center portion of the radiated beam of the secondary radar sweeps the target, the target is swept also by the narrower beam of the interrogating radar. If the interrogating radar is operating in the S-band

(for example, the TOKEN class) or in the X-band (for example, airborne radars), in its beam the transponder will be triggered almost without delay by the simultaneous reception of the pulse from the interrogating radar (through the BEAN SHELL or PIN HEAD antennas) and of the first pulse in the interrogation pulse group of the secondary radar (coincidence). Target skin echo and response begin their return practically simultaneously.

Since no additional receiving antennas are available, interrogation radars operating in other frequency bands do not produce this immediate triggering; the SRO-2 will not respond until the third pulse in the group.

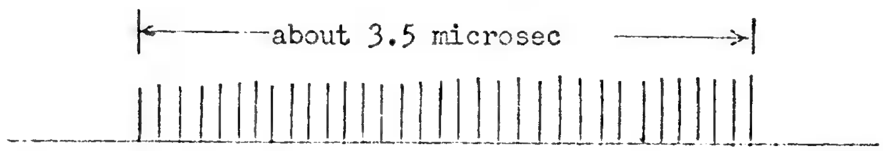
II. The Response

1. IFF Code: The response of the SRO-2 is transmitted nondirectionally with the frequency of the interrogation (670 MHz). The response signals are transmitted with the PRR of the interrogating radar as a pulse train with a width of about 3.5 microseconds; the PRR within the pulse train is the identification code. Twelve PRR's, i.e., twelve identification codes, can be selected by means of a step switch. They are:

| | | | |
|---|---|---|---|
| 1. 1.7 MHz | 4. 3.7 MHz | 7. 5.7 MHz | 10. 7.7 MHz |
| 2. 2.3 MHz | 5. 4.3 MHz | 8. 6.3 MHz | 11. 8.3 MHz |
| 3. 3.0 MHz | 6. 5.0 MHz | 9. 7.0 MHz | 12. 9.0 MHz |

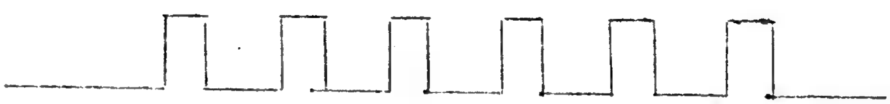
Whenever the pilot trips the switch marked "бедствия" (distress), a second pulse train 3.5 microseconds wide is transmitted with a spacing of 7 microseconds.

The figures a) b) and c) show the composition of the response pulse train for various codes. Depending on the code frequency, the widths of the individual pulses range from 200 nanoseconds down to 60 nanoseconds. Figure d) shows — on an exaggerated scale — the structure of the individual pulses.

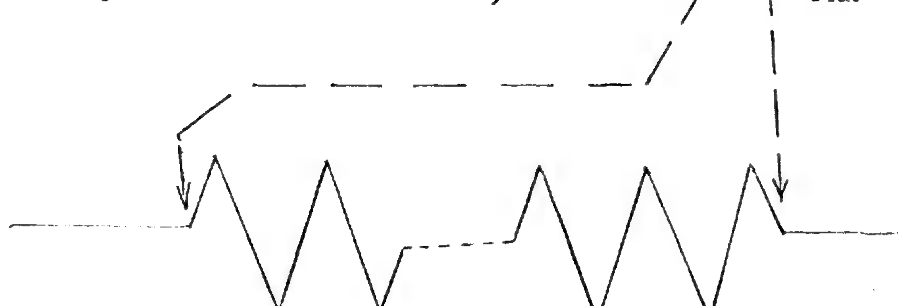



a) Response Pulse Train Code 12, PRR = 9.0 MHz

b) Response Pulse Train Code 6, PRR = 5.0 MHz



c) Response Pulse Train Code 1, PRR = 1.7 MHz



d) Structure of each individual pulse, the width of which is 60–200 nanoseconds, depending on the code PRR. The carrier frequency of 670 MHz is indicated.

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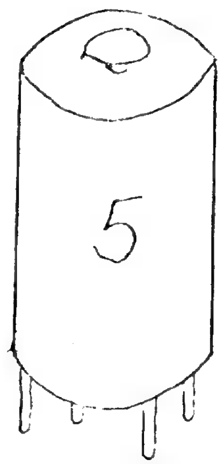
2. Testing the Interrogation Signal: The IFF code frequency of the received response signals is checked by means of interchangeable filters. Two filters, which appear to be the same on the outside, are required (for example, plug-in crystals), which have the numbers 1-12 on them, corresponding to the above-described 12 PRR's ranging from 1.7 to 9.0 MHz. The IFF code setting in the aircraft and the filters in the transponder receiver must agree in order for an indication of the response to be possible.




Interchangeable filter No 5
(for Code Frequency 4.3 MHz)

III. The Indication

1. Response Representation On PPI-Display of Interrogating Radar

After they have been checked, the response signals are converted into video signals and displayed on the PPI of the interrogating radar as a marker pip. It coincides in azimuth with the target skin echo, but its range can be greater. When the "distress" signal is switched on in the aircraft, a double, or more intense, marker pip appears.



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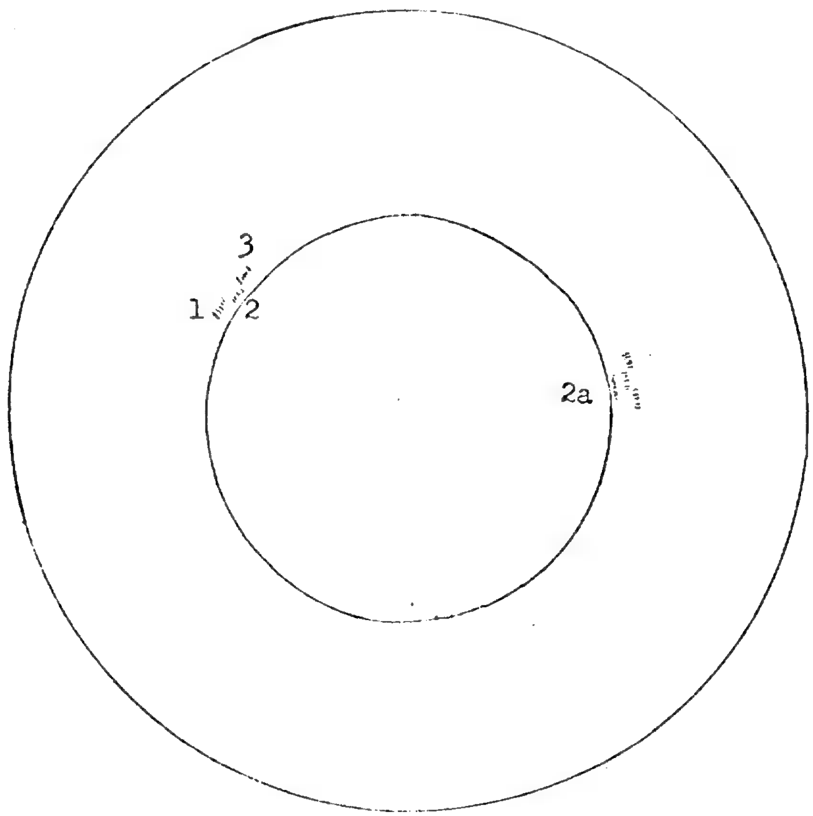
a) Interrogating Radar in the S-Band: The interrogating radar is assumed to be a TOKEN class radar (for example, BAR LOCK). The narrower S-band beam and wider beam of the secondary radar are synchronized in time and direction. Whenever an aircraft equipped with the SRO-2 is contacted, the SRO-2 is first swept by the wider beam of the interrogating secondary radar and triggered by the third pulse in the interrogation pulse train, and the response (1 in sketch below) is represented on the PPI display as an arc about 3° wide.




When interrogating radar beam and secondary radar beam pass through simultaneously, the SRO-2, because of the coincidence with the interrogation radar pulse, responds to the first pulse in the interrogation pulse train,

that is about 10 microseconds or, with respect to range, 1.5 kilometers earlier than response 1 in the sketch. This earlier response (2 in the sketch) is thus located on the PPI screen about 1.5 kilometer inside the first part of the response. (With a measurement range of 200 kilometers this amounts to about one millimeter on the scope.)

Once the S-band beam sweeps past, the SRO-2 again responds to the third pulse in the interrogation pulse train; the answer (3 on the sketch) is recorded as a $3^{o}$ arc which, like the first part of the response, is about 1.5 kilometers farther out in range. This response representation with the pronounced wing-like arcs is also called "the bird".

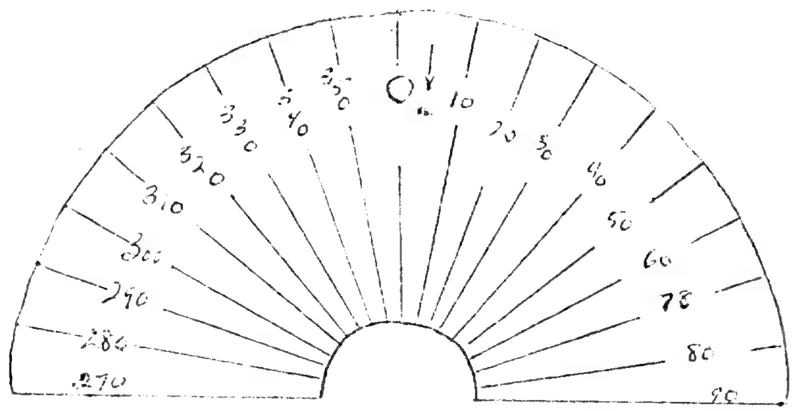
In the center portion of response 2 the pip of the target skin echo and the SRO-2 response pip practically coincide. Presumably a delay can be switched in for the video signals of the SRO-2 as a means of separating the target skin echo pip (2a in the sketch).

In the sketch, targets 2 and 2a are on the same range ring; in the case of 2a a delay was switched in for the SRO-2 video signals. Both types appear in operation . (See Enclosure 18)

b) <u>Interrogating Radar in the X-Band</u> (e.g., TOAD STOOL)

The representation is analogous to that described above. Whenever the third (or even second and third) pulse in the interrogation pulse train is absent, as is the case with airborne interrogation radars, the response pip consists of only the central arc (2 on the sketch); arcs 1 and 3 will be absent. Separation of the target skin echo and SRO-2 response would necessitate delaying the latter.

Sketch shows navigation scope of the TOAD STOOL:

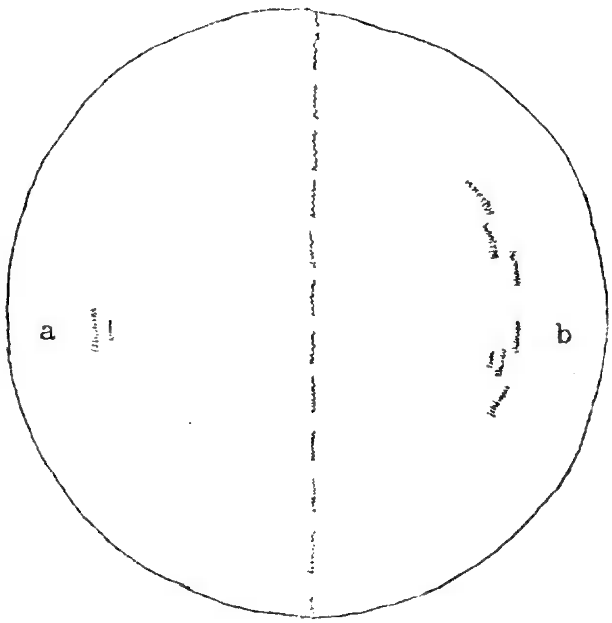



The response appears on the screen of the interrogating airborne radar and in many cases looks different than shown here. It depends on the type of indication used in the airborne radar.

c) Interrogating Radar In the L-Band: In aircraft which, along with the SRO-2, also have the SOD-57 M, a coincidence triggering of the SRO-2 and thus a response indication in stages would be possible, for example with the use of the L-band antenna, even FLAT FACE (possibly even LONG TALK and ONE EYE), with the operating switch on "SRO-2", but in such a case the arcs would be about twice as wide, as is the case with BAR LOCK, for example (See b on the sketch below).

A separation of target echo pip and SRO-2 response pip is not possible in this case.

The sketch shows the representation of the response on the PPI scope of an interrogating radar operating in the L-band.

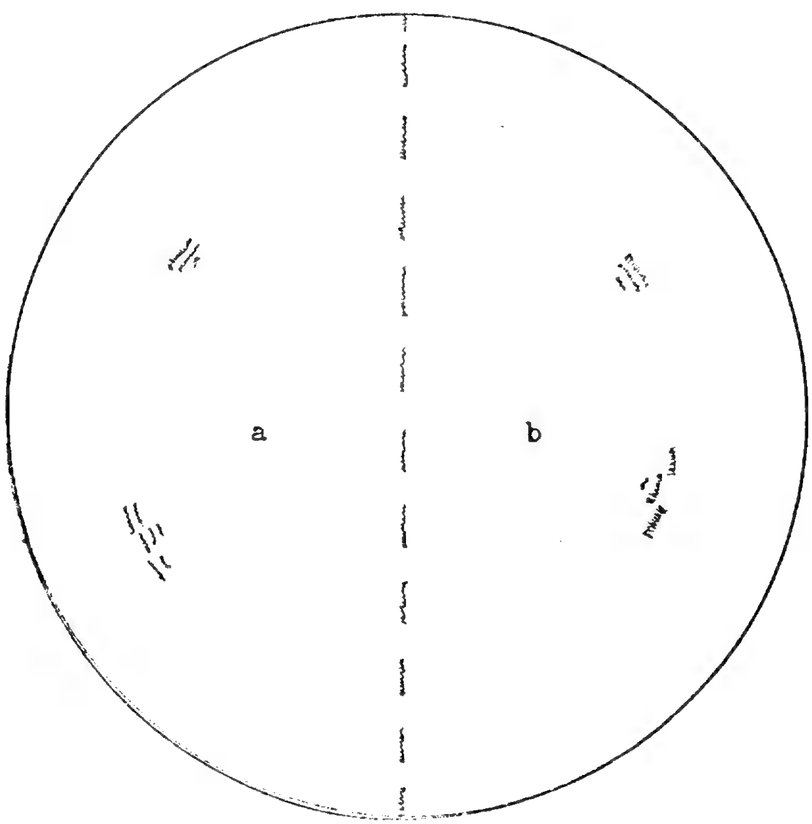



d) Interrogating Radar In the Metric Wave Range

In the case of interrogation radars which operate on the longer wavelengths (and thus have correspondingly wider beams), the capability of the SRO-2 of responding to the first pulse of the interrogation pulse train (670 MHz) in coincidence with the interrogation radar pulse cannot be exploited, since

the appropriate receiving antennas are not available. The response representation consists of an arc (without gradation); target skin echo and SRO-2 response are separated from one another by about 10 microseconds = 1.5 kilometers. (See a in sketch above.)

e) Distress Signal: When the "distress signal" is tripped in the aircraft, nothing described above regarding the configuration of the scope indications is changed. Depending on the distance range used, the representation is either doubled (See a in sketch below; spacing is 7 microseconds = 1 km.) or intensified (b in sketch below).




Indication of the Distress Signal On the PPI-Scope of the Interrogating Radar

E. Technical Problems in the Case of the Secondary Radar

Some technical problems that arise in the case of the secondary radar are discussed below from the point of view of their effects in the case of the SRO-2: These include: unsynchronous responses (fruit); minor lobe interrogations; interrogation through reflections; overranges; and garbling.

I. Unsynchronous Responses (Fruit)

Since the responses of the SRO-2 are nondirectional (The situation is changed very little even when we assume that two ODD RODS antennas, each with 135° halfwidth, are mounted in nose and tail.), even enemy radars can receive and process the responses. Since they also can be received through minor lobes, and the timing relationship is lacking (they are not PRR-synchronized), they will be indicated on the display at incorrect locations. (Such responses do not appear as "birds." The "birds" are always distorted to one degree or another and most likely not at all recognizable as "birds.") The same conditions occur during the reception of enemy target skin echoes. When the flight density is rather great, particularly with so thin a network of radars as that employed in the Soviet block, bright spots on the scope would appear as indication of nonsynchronous responses or echoo s (called "fruit", and the device to suppress it "defruiter"). Thus measures must be taken to suppress such nonsynchronous responses or interferences. Defruiters are known to be used with various Soviet radars (for example, in the BIG BAR, storage tubes are used for this purpose). It can be assumed that defruiters are standard equipment in Soviet radars, even where no secondary radar is used.

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II. Minor Lobe Interrogations

Responses can be indicated with incorrect azimuth by minor lobe interrogations, which exert their influence primarily in closer ranges.

In the case of the SRO-2 an unequivocal azimuth determination is provided at close ranges by the passage of the sharply focussed primary radar beam. (presentation of the clearly defined "bird" figure on the scope) In this manner the indication of responses to minor lobe interrogations can be suppressed.

It is possible that,in the reception, a monopulse procedure is also used, which would result in a very effective minor lobe suppression during the response process. The dipole pairs of the primary radiators of various radars (BAR LOCK and HEAD NET, for example) could be used for the purpose.

III. Interrogation Through Reflections

The SRO-2 has a dead time (minimum period between two responses) of about 20-30 microseconds. Thus a triggering of the transponder by reflections of the interrogation radiations (through buildings, etc) is not to be expected.

IV. Overranges

Ambiguity in range indications could be avoided by a process found in nearly all Soviet radars and called "ВАРУ" for "временное автоматическое регулирование усиления" (time-varied automatic gain control), a near-echo suppression circuit. Responses from distances greater than the range limit selected, which arrive with lower intensities, also arrive at a time when receiver sensitivity is reduced, and are suppressed.

Attachment



V. Garbling

Garbling is a code mutilation resulting from the mixing of the responses of two aircraft which are flying on the same azimuth bearing and whose separation from each other is shorter than the corresponding width of a response pulse train. Since with the SRO-2 the width of a response pulse train is only 3.5 microseconds, corresponding to a distance of only 525 meters, the probability of garbling is much lower than, for example, Western secondary radars (20 microseconds, corresponding to 3 kilometers). When the situation arises, indication on the scope of the mixed, garbled responses is prevented by the "code filter."

F. Difference Between the SRO-2 and the SRO-1

The main differences between the SRO-2 and the SRO-1 are to be found in the four following areas:

- operating frequency
- interrogation
- response
- response representation.

I. Operating Frequency: The SRO-2 operates on a fixed frequency of about 670 MHz. The SRO-1, on the other hand, operates with a wobbled frequency in the 150-180-MHz range. Individual interrogating radars which operate on a fixed frequency within this range have always been able to acquire such separated responses on their frequencies.

II. Interrogation: The SRO-2 responds to two types of interrogations: 1. a three-pulse train with 4.5 microsecond spacing; 2. a coincidence of a 670-MHz pulse and an interrogating radar pulse in the S-band or X-band (at times even in the L-band).

The SRO-1 interrogation was not coded; only a pulse width of at least 5 microseconds was required.

III. Response: The SRO-2 has 12 identification codes in the form of 12 pulse repetition rates and one pulse train with a width of 3.5 microseconds. The SRO-1 had 28 five-digit Morse combinations as the identification code. Transmission of each five-digit code took 3.2 seconds.

IV. Response Representation: The SRO-2 response is blended into the PPI indication of the interrogating radar as an additional marker pip. The SRO-1 response was represented on an A-display, and the azimuth was read off a separate scale.

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SECRET
NO FOREIGN DISSEM

Attachment

50X1-HUM

ENCLOSURE 1

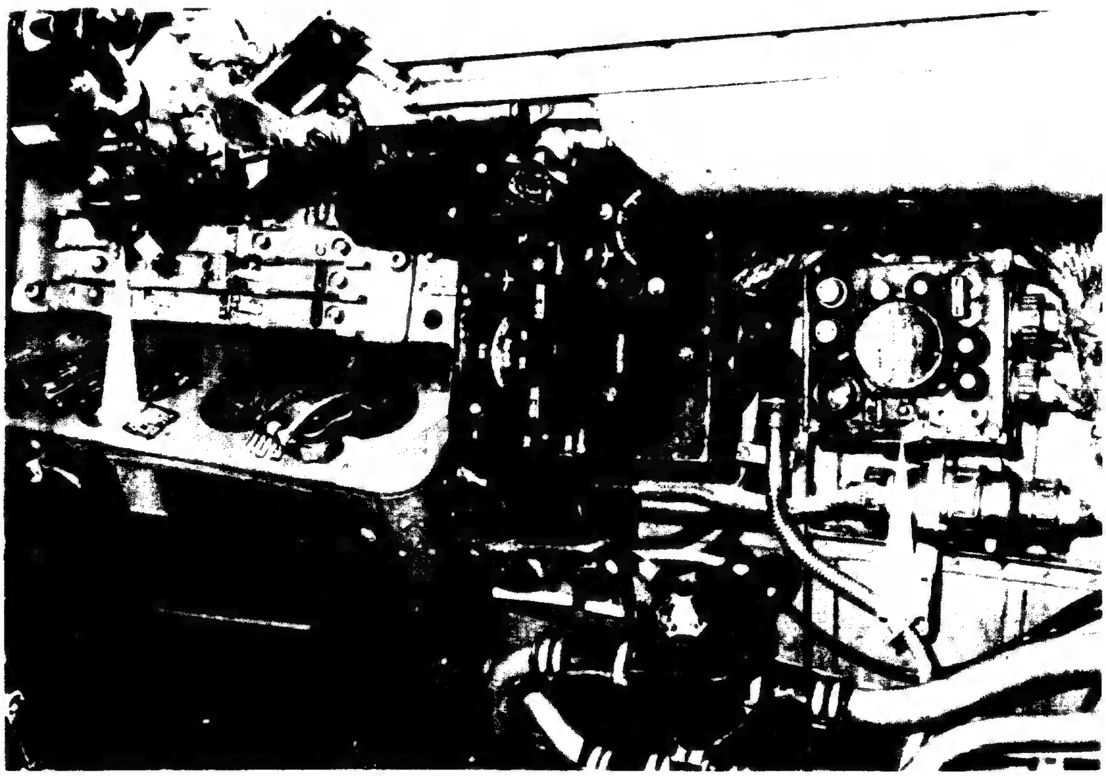

Figure 1. Destruct Switch (Arrow on Left) and Control Box (Arrow on Right) in the Right Control Panel

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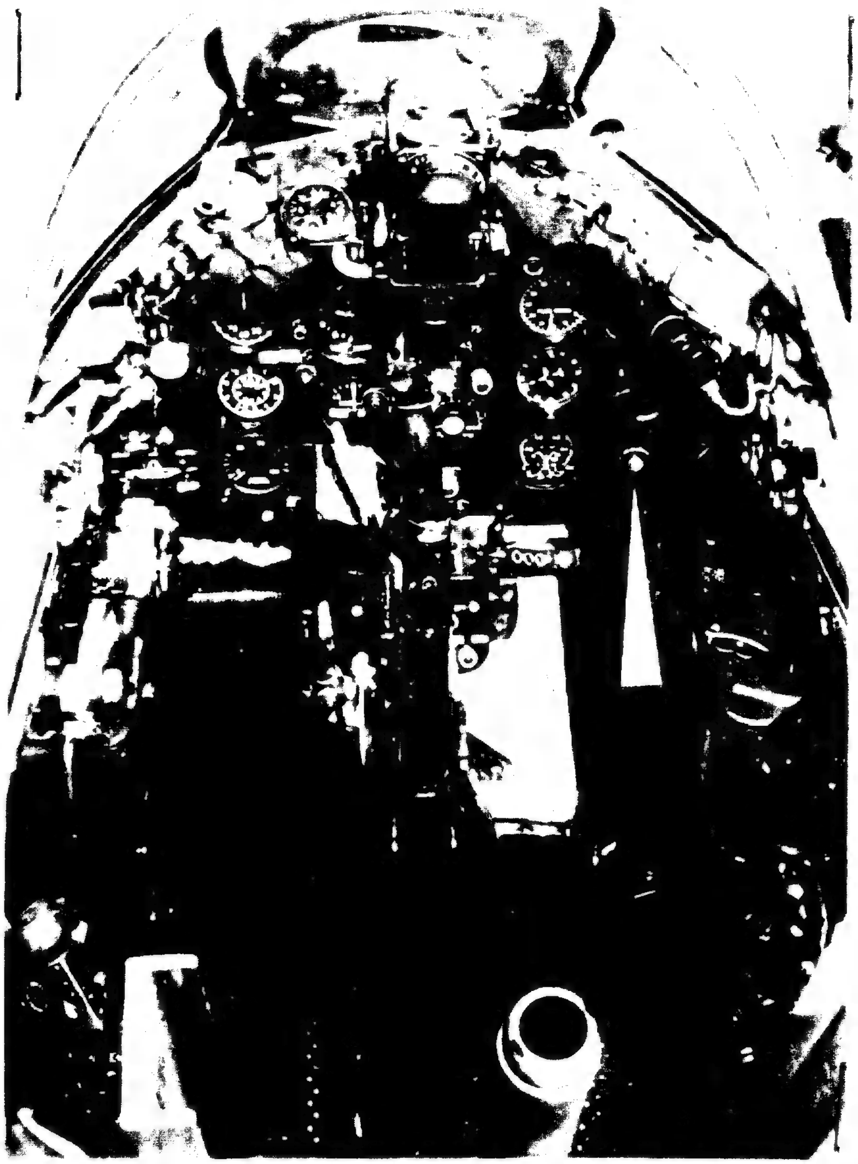
50X1-HUM



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Attachment [redacted]

50X1-HUM

ENCLOSURE 3

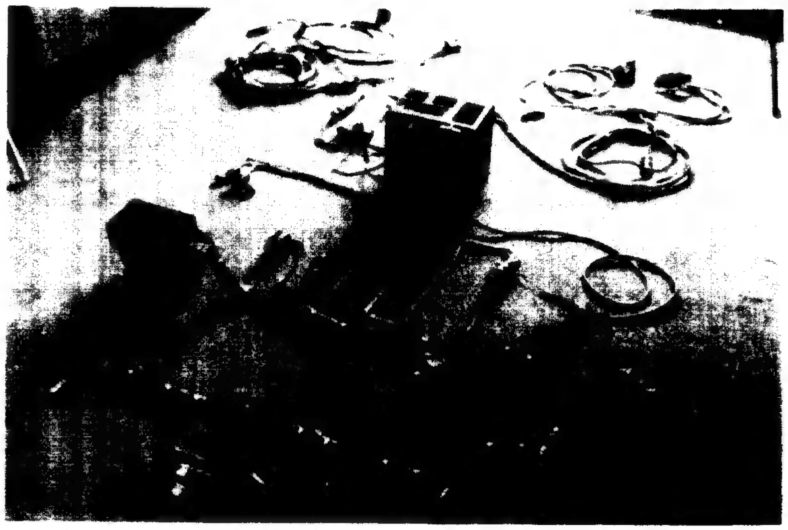


Figure 3. General View

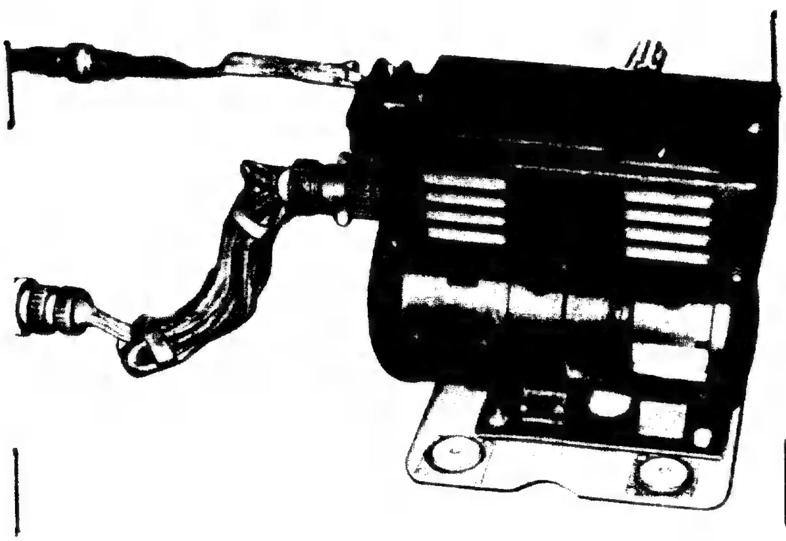


Figure 4. Converter With Power Pack

Attachment

50X1-HUM

ENCLOSURE 4

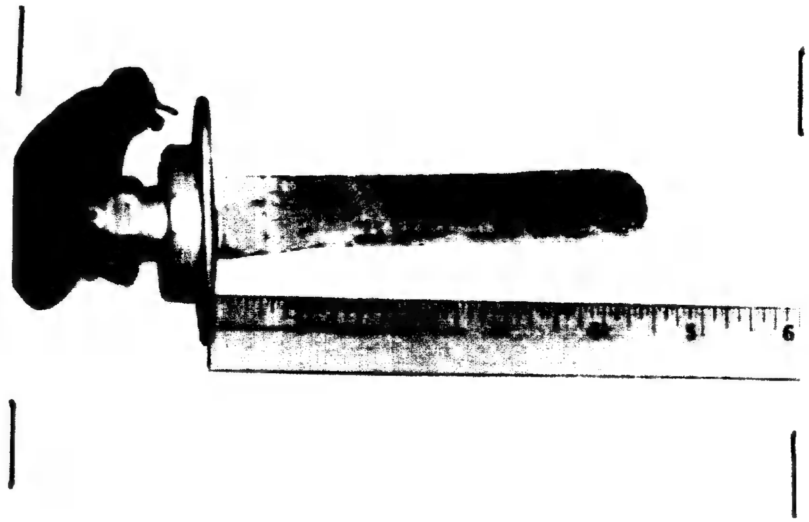


Figure 5. Transceiver Antenna (ODD RODS - Variation)

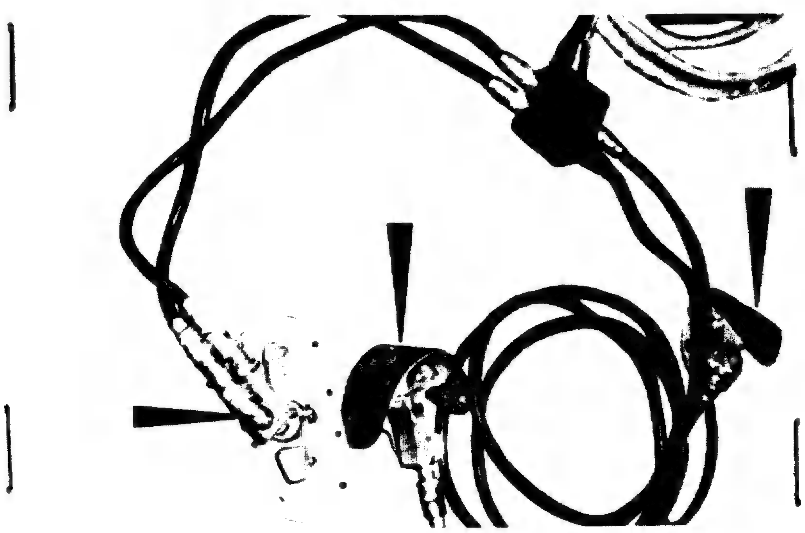


Figure 6. Receiving Antennas: BEAN SHELL (Horizontal Arrow) and PIN HEAD (Vertical Arrow)

Attachment

ENCLOSURE 5

50X1-HUM

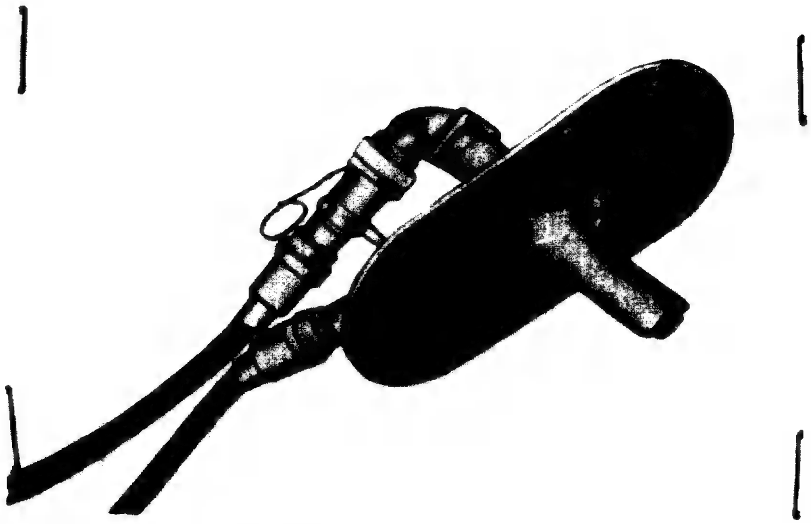


Figure 7. BEAN SHELL

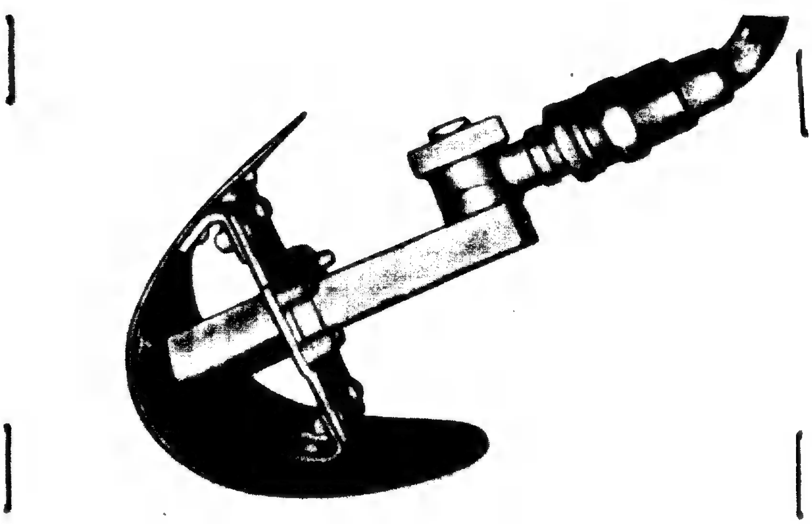


Figure 8. FIN HEAD

S E C R E T
No Foreign Dissem

ENCLOSURE 6

50X1-HUM

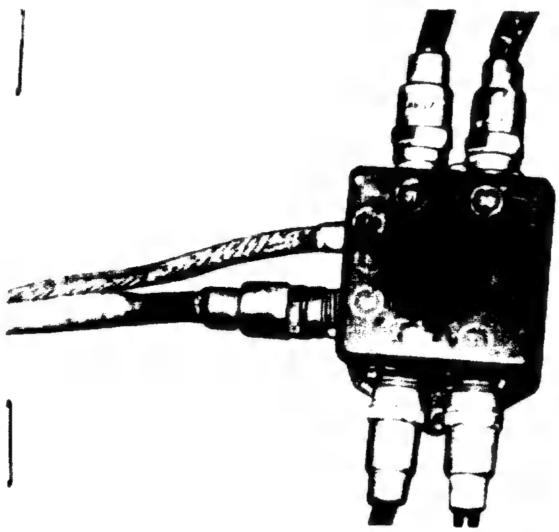
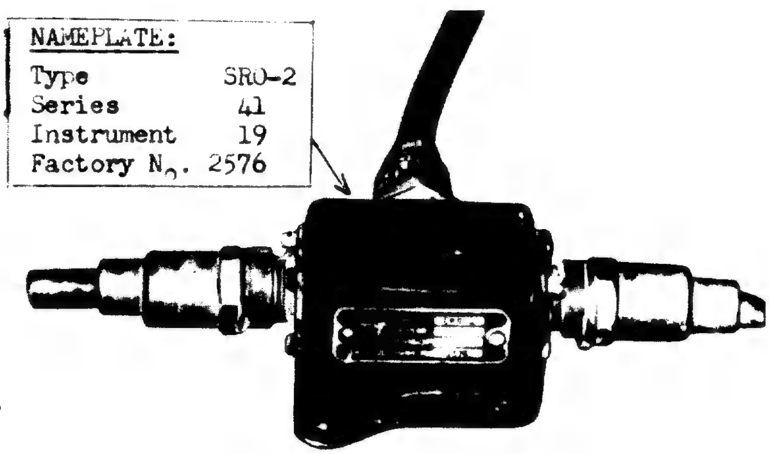
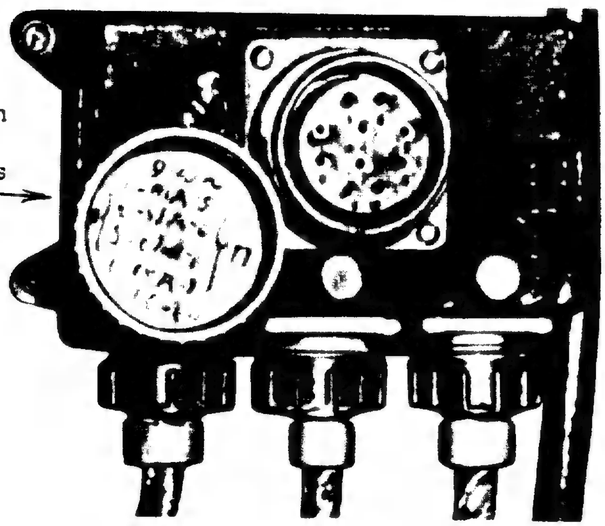


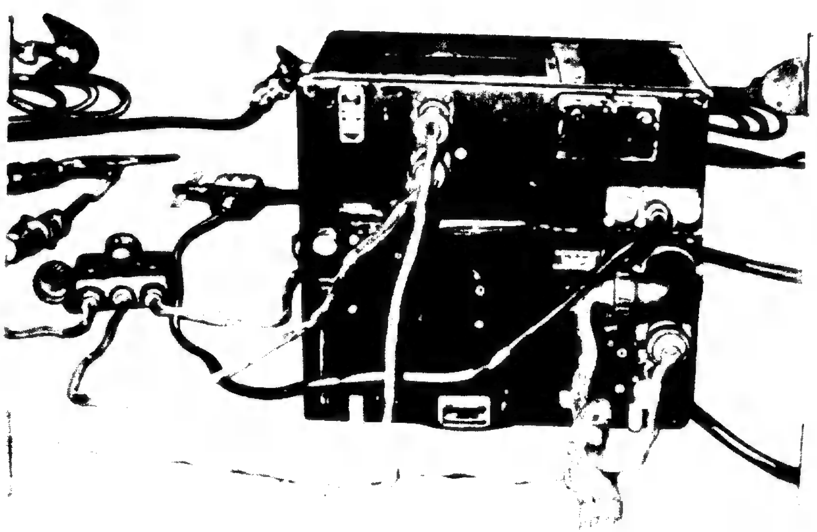
Figure 7. Unit 23 I



ENCLOSURE 7

and-
written
iode
umbers





Attachment

ENCLOSURE 8

50X1-HUM

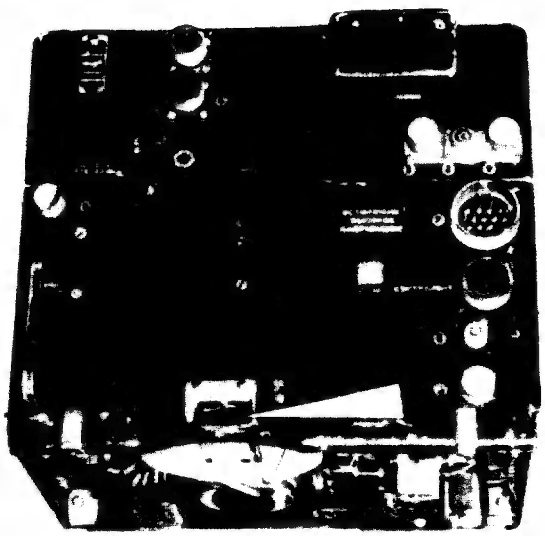


Figure 13. The Transceiver

(Arrow points to hole for the self-destruct explosive charge.)

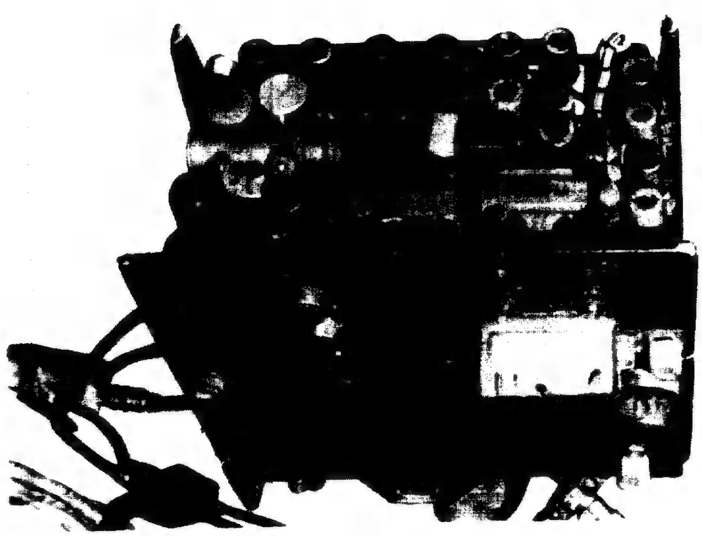


Figure 14.

The Transceiver

Attachment



ENCLOSURE 9

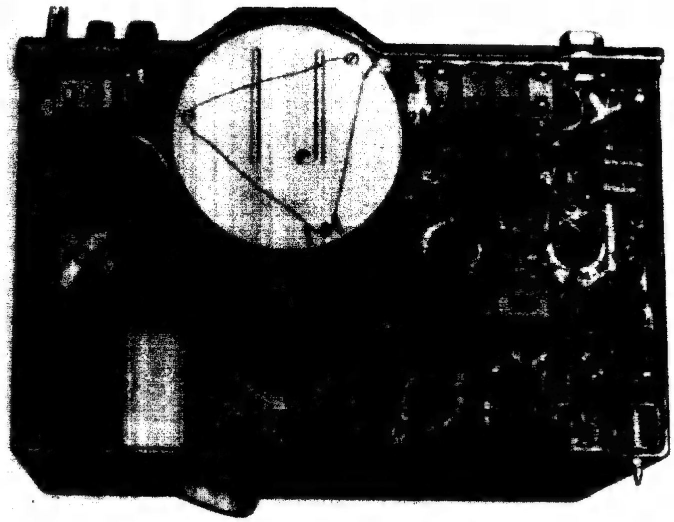


Figure 15. The Transceiver

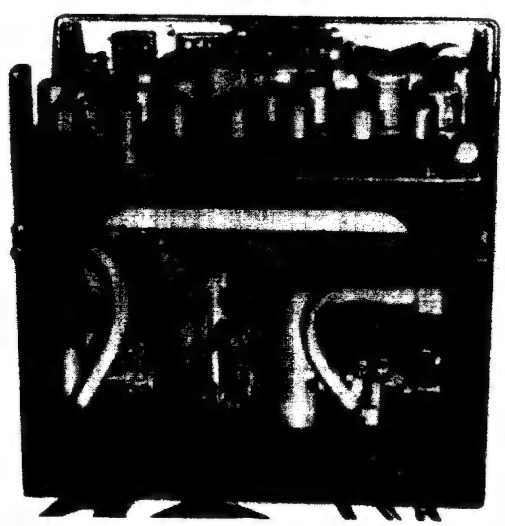


Figure 16. The Transceiver

Attachment

50X1-HUM

ENCLOSURE 10

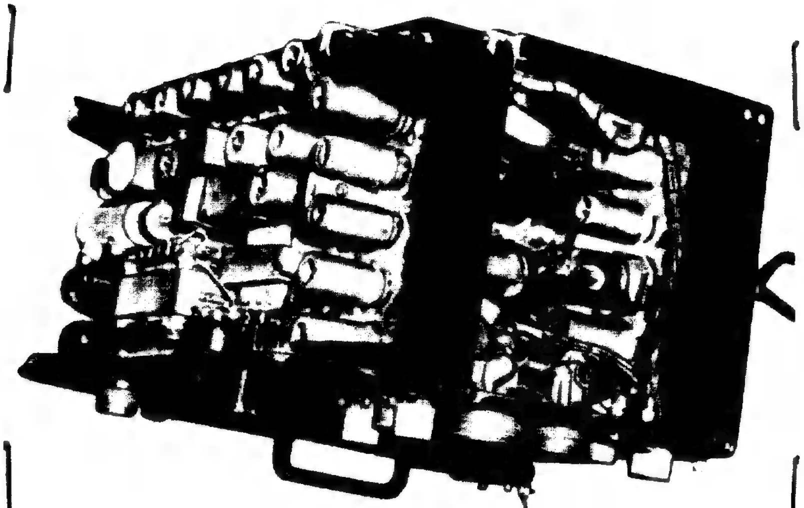


Figure 17. The Transceiver

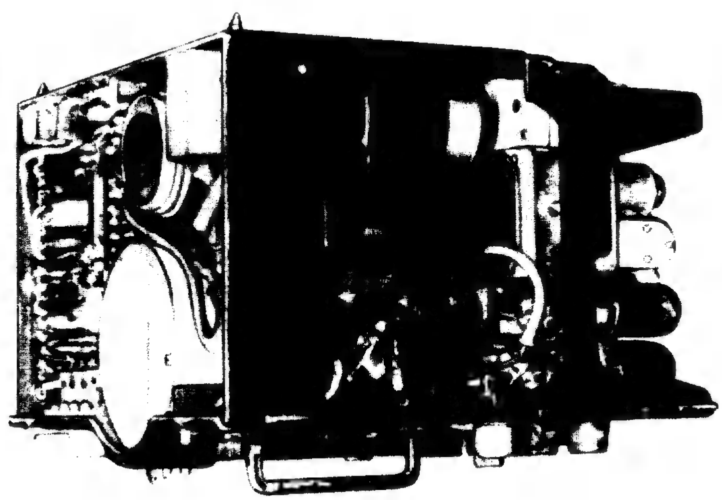


Figure 18. The Transceiver

Attachment

50X1-HUM

ENCLOSURE 11

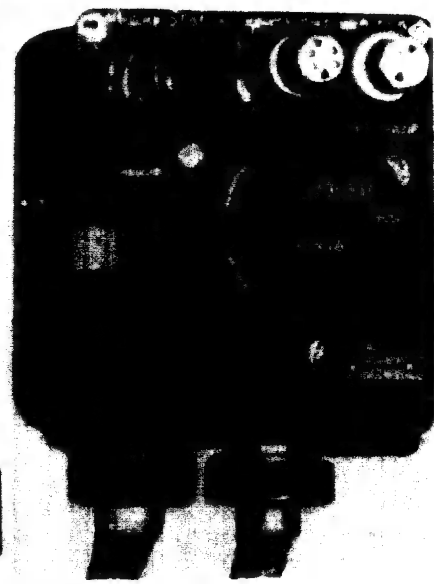
Figure 19. IFF-Code-Setting Knob

Figure 20. IFF-Code-Setting Knob

Attachment

50X1-HUM

ENCLOSURE 12



Inscription On Knob Cover:

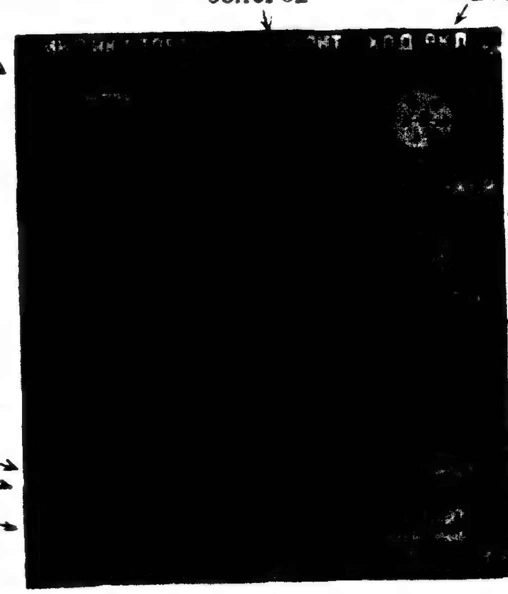
"DISCONNECTED. USE REMOTE"

Figure 21. Control Box

Response Indication

Power Control

Code Switch



Voltage Regulation

Start
10 amps

Lower Left:

400 Hz 115 v

400 Hz 3 amp

27 v 3 amp

Power Toggles, Mechanically Coupled For Code and Power

Figure 22. Control Box With Cover of IFF-Code-Setting Knob Removed

Attachment

50X1-HUM

ENCLOSURE 13

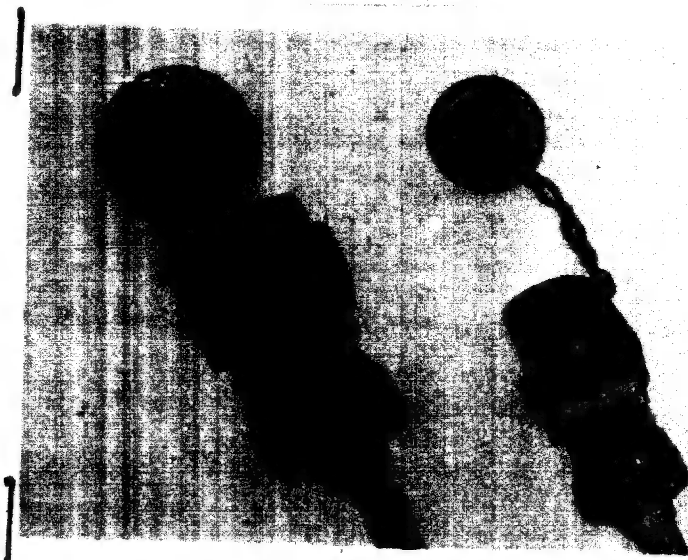


Figure 23. Test Connections

Figure 24. Self-Destruct Explosive Charge

S E C R E T
NO FOREIGN DISSEM

Attachment to

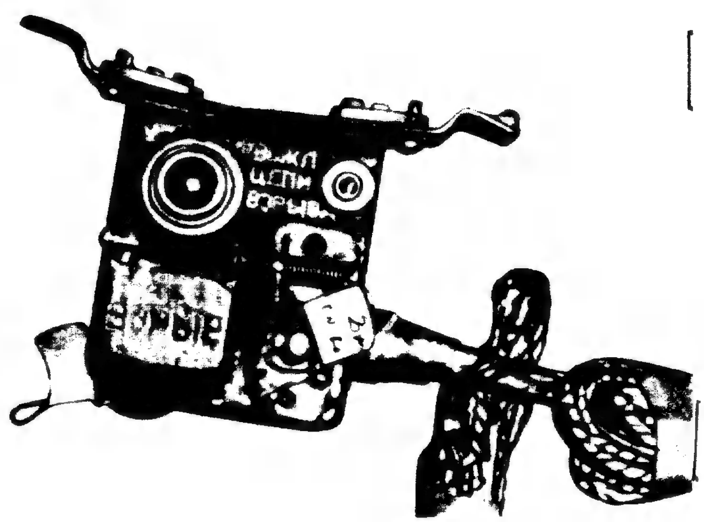
50X1-HUM

ENCLOSURE 14

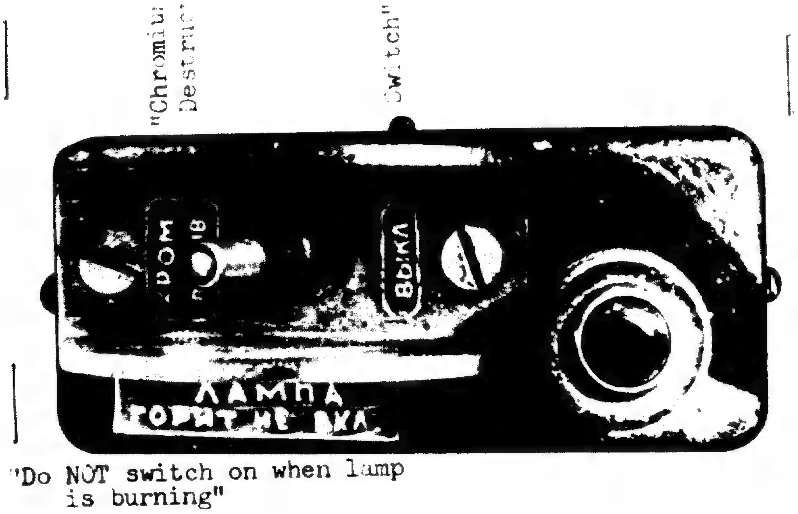
Inscription:

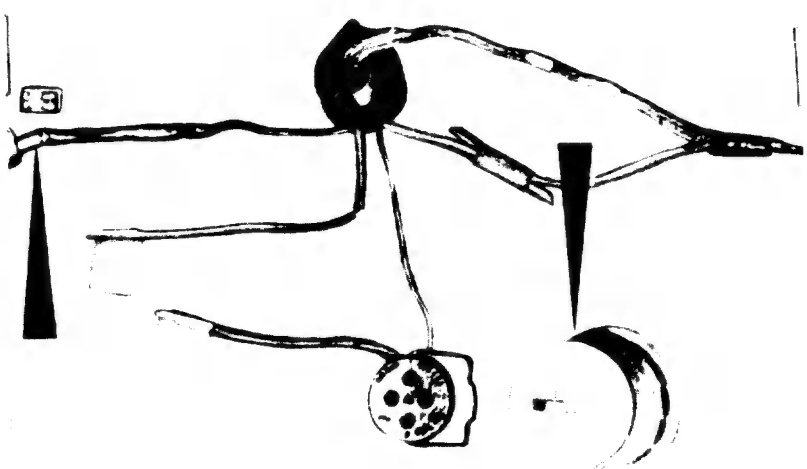
"Adjustable to 10 g"

Figure 25. Inertial Switch

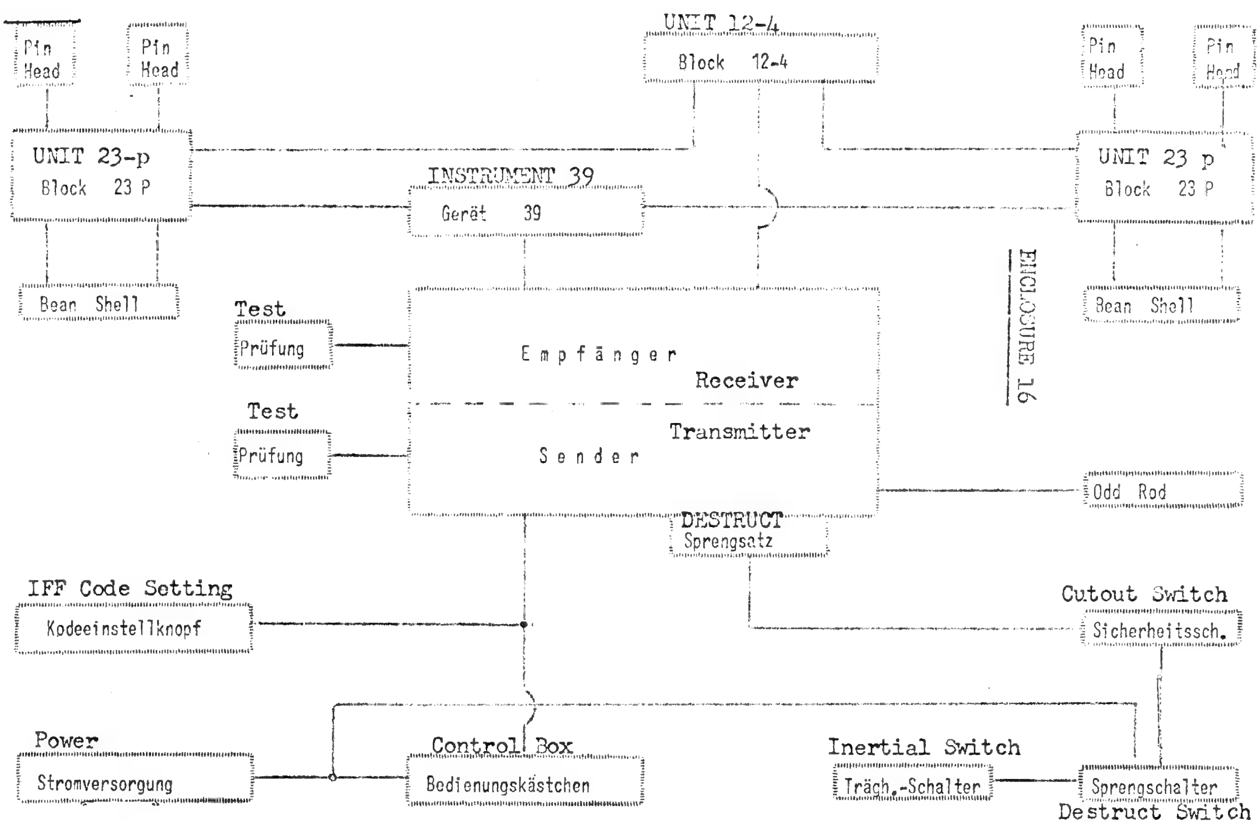


[illegible]


"Chromium Destruct"
"Switch"
ХРОМ
ВЫКЛ
ЛАМПА
"Do NOT switch on when lamp is burning"



ENCLOSURE 16



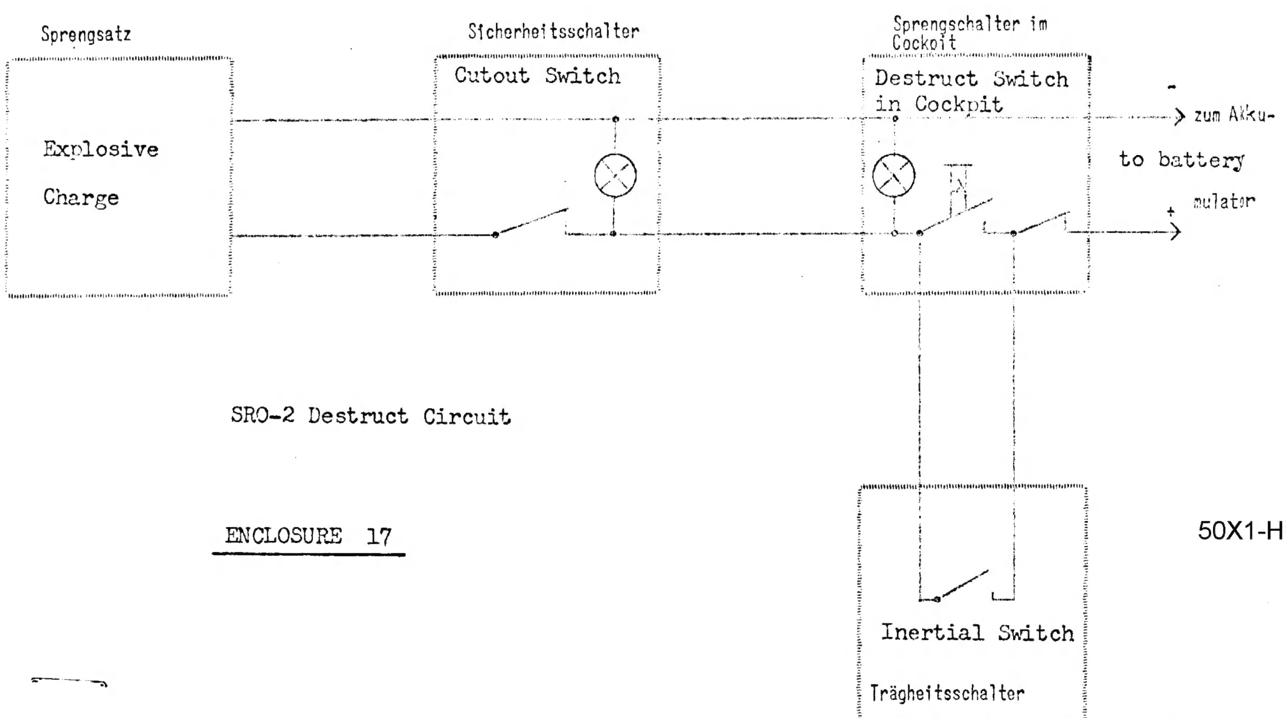

Blockschaltbild des SRO-2 (Block Diagram of the SRO-2)

S E C R E T
NO FOREIGN DISSEM

- 42 -

Attachment

50X1-HUM




SRO-2 Destruct Circuit

ENCLOSURE 17

SECRET
NO FOREIGN DISSEM

50X1-HUM

Attachment

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## L e g e n d

a - Interrogation Radar Pulse (Depends On Radar Used)

a' - Skin Echo of Interrogation Radar Pulse

b - Interrogation Pulse Group (670 MHz)

c - SRO-2 Response to Coincidence

d - SRO-2 Response to 3d Interrogation Pulse

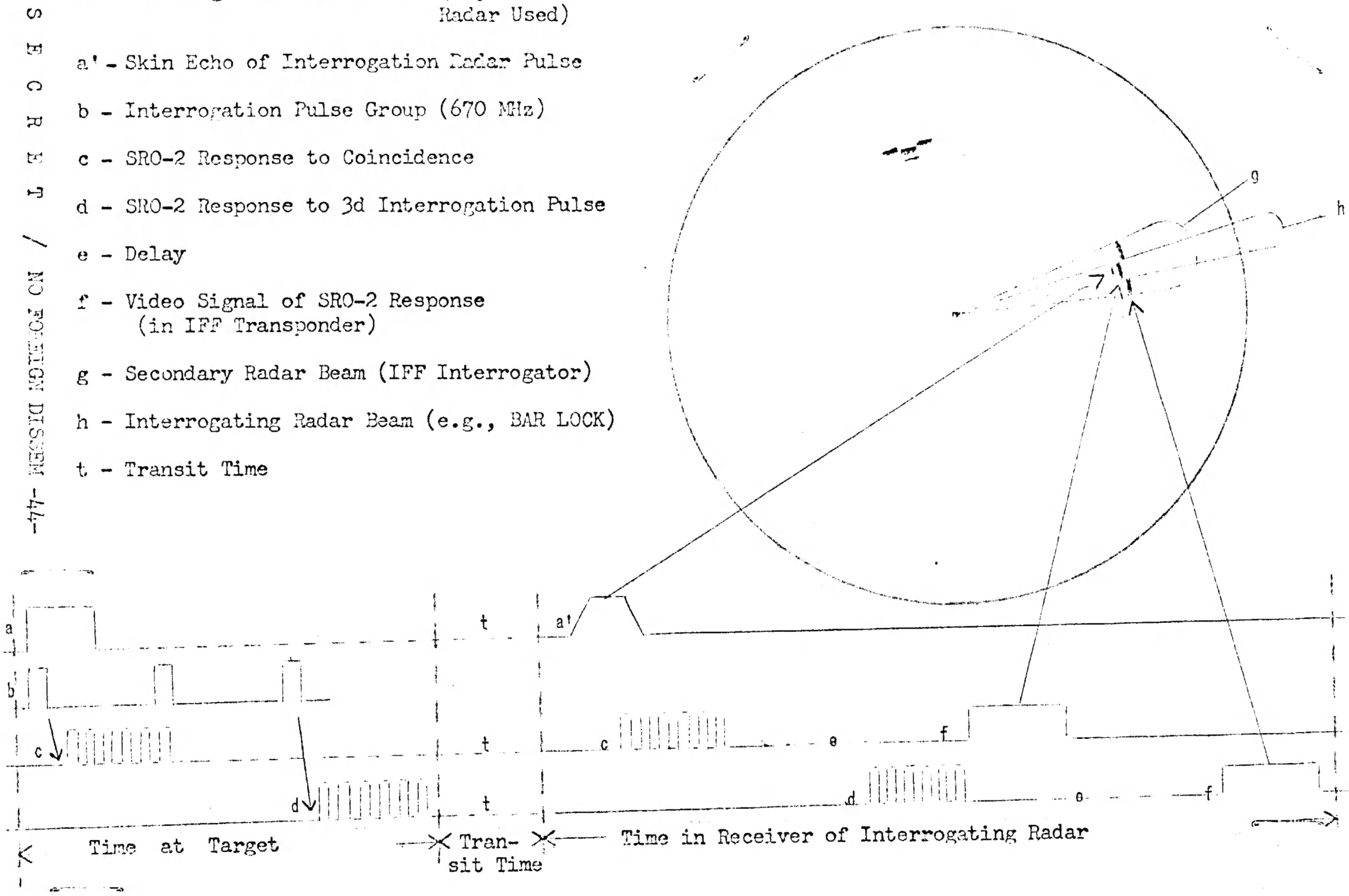
e - Delay

f - Video Signal of SRO-2 Response (in IFF Transponder)

g - Secondary Radar Beam (IFF Interrogator)

h - Interrogating Radar Beam (e.g., BAR LOCK)

t - Transit Time




Attachment

50X1-HUM

Attachment

50X1-HUM

# ENCLOSURE 19

## Comparative Data On the SRO-2 and SRO-1

| | "CHROMIUM" SRO-2 | "BARIUM" SRO-1 |
|---|---|---|
| Operating Frequency | 670MHz | 150-180 MHz (Range covered every 0.65 second) |
| Polarization | vertical | vertical |
| Transmitting/Receiving Antenna | λ/4 sword (or 2 ODD RODS) | λ/4 sword |
| Interrogation | coded for 670 MHz or coincidence | not coded; fixed frequency in range 150-180 MHz |
| Dead Time | 21-28 microsec | 35 microsec |
| Number of Possible IFF Codes | 12 | 28 |
| IFF Code | PRR (1.6 - 9.0 MHz) | 5-digit Morse combination |
| Duration of Transmission per Response | 3.5 microsec | 3.2 seconds |
| Response Representation | on PPI scope of Interrogating radar | on A-scope; azimuth on separate scale |
| Receiving Antennas | BEAN SHELL<br>PIN HEAD | ------------<br>------------ |
| Manufacturing Technology | traditional robust | tradition robust |
| Number and Type of Vacuum Tubes | 31 shielded miniature tubes | 11 tubes |
| Size of Transmitter Housing | 32 x 30 x 20 cm | 32 x 30 x 20 cm |
| Self-Destruct Components and Circuit | transferred without change from SRO-1 | |